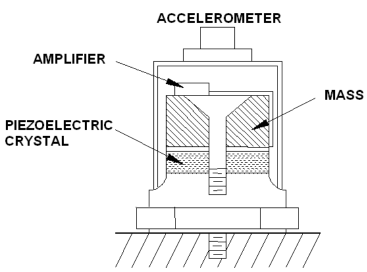
Accelerometer Installation ACCEL

Accelerometers have always been a popular choice for rotating machinery vibration monitoring. They are a rugged, compact, light weight transducer with a wide frequency response range. This transducer is typically attached to the outer surface of machinery. Generally this machinery will have parts that generate high frequency signals, such as, rolling element bearings or gear sets.

The application and installation of an accelerometer must be carefully considered for an accurate and reliable measurement. Accelerometers were designed to be mounted on machine cases. This will provide continuous or periodic sensing of absolute case motion (vibration relative to free space) in terms of acceleration.

Theory of Operation



Accelerometers are inertial measurement devices that convert mechanical motion to an electrical signal. This signal is proportional to the vibration's acceleration using the piezoelectric principle. Inertial measurement devices measure motion relative to a mass. This follows Newton's Third Law of Motion: A body acting on another will result in an equal action on the first.

Accelerometers consist of a piezoelectric crystal and mass normally enclosed in a protective metal case. As the mass applies force to the crystal, the crystal creates a charge proportional to acceleration. The charge output is measured in pico Coulombs per g (pC/g) terms where g is the force of gravity. Some sensors have an internal charge amplifier, while others have an external charge amplifier. The charge amplifier converts the charge output of the crystal to a proportional voltage output in mV/g terms.

Current or Voltage Mode

This type of accelerometer has an internal, low-output impedance amplifier and requires an external power source. The external power source can be either a constant current source or a regulated voltage source.

This accelerometer is normally a two-wire transducer with one wire for power and signal, and the second wire for common. This type of Accelerometers has a lower temperature rating due to the internal amplifier circuitry. Signal cable lengths up to 500 feet have negligible effect on the output signal quality. Longer cable lengths will reduce the effective frequency response range.

Charge Mode

Charge mode accelerometers differ slightly from current or voltage mode types. This sensor has no internal amplifier and therefore has a higher temperature rating. An external charge amplifier is supplied with a special adapter cable, which is matched to the accelerometer. Field wiring is terminated to the external charge amplifier. As with current or voltage mode accelerometers, signal cable lengths up to 500 feet have negligible effect on the output signal quality. Longer cable lengths will reduce the effective frequency response range.

Special Considerations

Mounting

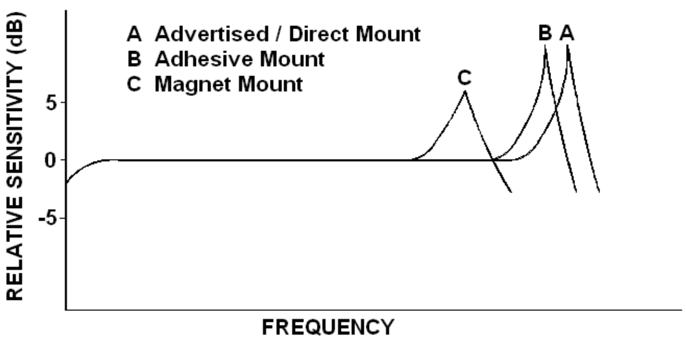
There are three mounting methods typically used for monitoring applications: bolt mounting, glue, and magnets.

The bolt mounting method is the best method available for permanent mounting applications. This method is accomplished via a stud or a machined block. This method permits the transducer to measure vibration according to the manufacturer's specifications. The mounting location for the accelerometer should be clean and paint free. The mounting surface should be spot-faced to a surface smoothness of 32 micro-inches. The spot-faced diameter should be 10% larger than the accelerometer diameter. Any irregularities in the mounting surface preparation will translate into improper measurements or damage to the accelerometer.

The adhesive or glue mounting method provides a secure attachment without extensive machining. However, this mounting method will typically reduce the operational frequency response range. This reduction is due to the damping qualities of the adhesive. Also, replacement or removal of the accelerometer is more difficult than any other attachment method. Surface cleanliness is of prime importance for proper adhesive bonding.

The magnetic mounting method is typically used for temporary measurements with a portable data collector or analyzer. This method is not recommended for permanent monitoring. The transducer may be inadvertently moved and the multiple surfaces and materials of the magnet may interfere with or increase high frequency signals.

As can be seen in the figure above, the mounting method also has an effect on the operating frequency range of an accelerometer. By design, accelerometers have a natural resonance, which is 3 to 5 times higher than the advertised high-end frequency response. The frequency response range is limited so that a flat response is provided over the operating range. The advertised range is achievable only by bolt mounting. Any other mounting method will adversely affect the natural resonance, and in turn the usable frequency response range.



Sensitivity

Accelerometers utilized for vibration monitoring are usually designed with a sensitivity of 100 mv/g. Accelerometers can be supplied with a wide range of sensitivities for special applications such as structural analysis, geophysical measurement, or very high frequency analysis.

Frequency Range

Accelerometers are designed to measure vibration over a given frequency range. Once the particular frequencies of interest for a machine are known, an accelerometer may be selected. Typically, an accelerometer for measuring machine vibration will have a frequency range from 1 or 2 hertz to 8 or 10k hertz.

An accelerometer is used on machines when high frequency measurements are desired. In terms of energy sensed by the transducer, acceleration will have larger amplitudes as the frequency increases. At low frequencies, the acceleration amplitudes may be quite small giving a false impression of an acceptably operating machine.

Calibration

Piezoelectric accelerometers cannot be recalibrated or adjusted. Unlike a velocity pickup, this transducer has no moving parts subject to normal wear. Therefore, the output sensitivity does not require periodic adjustments to correct for wear.

Accelerometers have internal components, which can be damaged from shock or overheating. When an accelerometer is suspect, a simple test of the transducer's bias voltage will help determine whether it should be removed from service. An accelerometer's bias voltage is the DC component of the transducer's output signal. The bias voltage is measured with a DC voltmeter across the transducer's signal output and common leads with power applied. At the same time, the power supply voltage should also be checked to eliminate the possibility of improper power voltage affecting the bias voltage level.

Instrument Wire

The following table is a partial list of Instrument wire that should be used for the instrument field wiring. These part numbers may be cross-referenced to equivalent cables from other manufacturers. The listed cables are polyethylene insulated, twisted, with shield, drain wire, and PVC jacket.

CMCP Part Numbers

Gauge	P/N	Nom. O.D.
18 AWG	CMCP-415-01	0.22"
20 AWG	CMCP-410-01	0.20"
22 AWG	CMCP-405-01	0.18"

Common Point Grounding

To prevent Ground Loops from creating system noise, system common, ground and instrument wire shield must be connected to ground at one location only. In most cases, the recommendation is to connect commons, grounds and shields at the monitor location. This means that all commons, grounds, and shields must be floated or not connected at the machine.

Occasionally, due to installation methods, instrument wire shields are connected to ground at the machine case and not at the monitor. In this case, all of the instrument wire shields must be floated or not connected at the monitor.

Conduit

Dedicated rigid conduit should be provided in all installations for mechanical and noise protection. The conduit should be metal, and in direct contact with each segment. All metal junction boxes and fittings should be in direct contact with the conduit. With this type of installation, a single ground point can be established.

To facilitate removal of the accelerometer, a junction box with a barrier terminal strip should be located close to the transducer. The rigid conduit should be attached to the junction box, and the final run to the transducer can be metal flexible conduit.

Accelerometer Checklist

1. Accelerometer Type: Current, Voltage, or Charge
2. Sensitivity
3. Frequency Range
4. Calibration
5. Correct Instrument Wire
6. Grounding
7. Rigid Conduit
8. Location(s) Documented

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